

Cruise Report

2016 RMP Bivalve Retrieval Cruise

Contract No. 1231

November 3, 2016

Submitted to:

San Francisco Estuary Institute
4911 Central Ave
Richmond, CA 94804

Submitted by:



4749 Bennett Drive, Suite L
Livermore, CA 94551
925-373-7142

1. Introduction

This report describes activities associated with the 2016 bivalve retrieval cruise of the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP). Measurement of contaminant concentrations in transplanted bivalves accumulated during dry season deployment is designed to provide long-term data on the bioaccumulation of trace elements and trace organic compounds in tissue throughout the Estuary.

Contaminant bioaccumulation in transplanted bivalve tissues is measured by collecting bivalves from sites that are known to have low contaminant concentrations and transplanting them to mooring locations in the Estuary. *Mytilus californianus* were collected from Bodega Head on June 7, 2016, and stored in filtered seawater tanks located at the Bodega Marine Laboratory (BML) until their deployment. During this depuration period, BML Aquatic Resources Group (ARG) personnel implemented a cleaning protocol to remove fouling organisms from each mussel to minimize potential for transfer of non-resident species from Bodega coast to San Francisco Bay.

Bivalves were attached to moorings at seven sites on June 28 - July 1, 2016. Bivalves were deployed in three cages at each site, with four compartments holding twenty-five bivalves in each cage.

One additional set of bivalves was collected as part of this sampling effort:

- Resident *Corbicula fluminea* were harvested nearby to long-term RMP water and sediment sampling locations on the Sacramento and San Joaquin River stations.

2. Cruise Report

2.1. Objectives

All sampling was conducted from the *RV Questuary*. The objectives of the sampling effort were as follows:

1. Retrieve mussels deployed at seven sites during the deployment cruise (June 28 - July 1, 2016).
2. As available, divide surviving bivalves as follows:
 - 150 bivalves for preparation of homogenate supporting analysis of PBDEs and PAHs (AXYS), Se (BAL), algal toxins (UCSC), emerging contaminants (SIU), and preparation of an archive (AMS).
 - 30 bivalves for analysis of growth by AMS
3. Obtain survival data at each transplant site.
4. Harvest resident *Corbicula fluminea* (CFLU) from two sites, historic San Joaquin River and Sacramento River stations.
5. Harvest 30 T-1 mussels from Bodega Marine Reserve (BMR) for analysis of growth only.
6. Collect a CTD water column profile at nine sites.

2.2. Personnel

The personnel and work assignments for this cruise are shown in Table 1.

Table 1. Personnel for 2016 RMP Bivalve Retrieval Cruise

Name	Affiliation	Duties	Contact
Steve Pengilley	Tenera	Dive tender	spengilley@tenera.com
Paul Salop	AMS	Cruise Manager, Diver, CFLU collections	salop@amarine.com
Winn McEnergy	AMS	Diver, CFLU collections	mcenery@amarine.com
Ila Shimabuka	SFEI	Assistance with processing bivalves	ilas@sfei.org
Kimberley D'Adamo Green	Berkeley Unified School District	Photography (10/5/16)	kimberleydadamo@gmail.com
David Morgan	RTC	Vessel Skipper	dmorgan@sfsu.edu

2.3. Sampling Activities

Sampling activities for the 2016 RMP Bivalve Cruise are shown in Table 2.

Table 2. Sampling Activities for 2016 RMP Bivalve Retrieval Cruise

Date	Time	Activity
Sept 30, 2016	1530-1930	Mr. Salop harvested T-1 mussels from Bodega Head for analysis of growth.
October 4, 2016	0700-0745	Mobilized gear aboard <i>RV Questuary</i> , Emeryville Marina. Departed for San Pablo Bay site (BD20).
	0830-0925	Checked mooring and retrieved bivalves and mooring from San Pablo Bay site. Departed for Pinole Point site (BD30).
	0942-1005	Checked mooring and retrieved bivalves and mooring from Pinole Point site. Departed for Vallejo Marina.
	1055-1120	Arrived Vallejo Marina and demobilized vessel. Mr. Pengilley retrieved all bivalves and returned them to cold storage at AMS.
October 5, 2016	0700-0725	Mobilized gear aboard <i>RV Questuary</i> , San Leandro Marina. Departed for Redwood Creek site (BA40).
	0845-0929	Checked mooring and retrieved bivalves and mooring from Redwood Creek site. Departed for Dumbarton site (BA30).
	0943-0957	Checked mooring at Dumbarton site; mooring completed covered by sediments, unable to be removed and left in place. Departed for Coyote Creek site (BA10).
	1015-1045	Checked mooring and retrieved bivalves and mooring from Coyote Creek site. Departed for Emeryville Marina.
	1246-1256	Arrived Emeryville Marina and demobilized vessel. Mr. Pengilley retrieved all bivalves and returned them to cold storage at AMS.
October 6, 2016	0800-0808	Mobilized gear aboard <i>RV Questuary</i> , Emeryville Marina. Departed for Alameda site (BB71).
	0850-0915	Checked mooring and retrieved bivalves and mooring from Alameda site. Departed for YBI site (BC10).
	0948-1008	Checked mooring and retrieved bivalves and mooring from YBI site. Departed for Emeryville Marina.

Date	Time	Activity
	1030-1130	Arrived Emeryville Marina and demobilized vessel. Mr. Pengilley retrieved all bivalves and returned them to cold storage at AMS.
October 13, 2016	0920-0938	Mobilized gear aboard <i>RV Questuary</i> , Pittsburg Marina. Departed for Sacramento River site (BG20).
	0953-1208	Collected resident <i>C. fluminea</i> from Sacramento River site. Departed for San Joaquin River (BG30) site.
	1230-1345	Collected resident <i>C. fluminea</i> from San Joaquin River site. Departed for Pittsburg Marina.
	1403-1425	Arrived Pittsburg Marina and demobilized vessel. Mr. Salop retrieved all bivalves and returned them to cold storage at AMS.

2.4. Sample Labeling

The sample ID system for all samples was as follows:

RMP-16BC-XXXX

Where:

RMP	=	Project
16	=	Cruise Year
BC	=	Matrix (Bivalve Cruise)
XXXX	=	Unique ID number

2.5. Discussion

T-0 samples were collected by hand from intertidal areas within BMR on June 6, 2016. All collected mussels were placed in rigid oyster bags and depurated in filtered seawater tanks operated by Bodega Marine Lab Aquatic Resource Group (ARG). Under the terms of AMS' Scientific Collecting Permit (SCP), all mussels were cleaned of fouling organisms by ARG personnel during this depuration period. AMS personnel retrieved all mussels on June 27, 2016, in preparation for deployments in San Francisco Bay.

AMS collected an additional 30 T-1 bivalves from BMR on September 30, 2016, which were immediately frozen after collection, then returned to AMS for analysis of bivalve growth only (i.e., no chemical analysis). We anticipate analysis of growth being completed by the end of the 2016 calendar year.

For deployed mussels and resident clams, full allotment of bivalves to support all target analyses were collected at primary mussel monitoring sites for T-0 mussels, Central Bay (BC10), South Bay (BA40), and San Pablo Bay (BD30). As in 2014, AMS deployed additional mussels at the following predetermined backup sites in case of loss or mooring or high mortality at the primary monitoring site for the region:

- Dumbarton Bridge (BA30) – backup site for both Lower South Bay (primary site BA10) and South Bay (primary site BA40) regions.
- Alameda (BB71) – backup site for Central Bay (primary site BC10) region.

- San Pablo Bay (BD20) – backup site for San Pablo Bay (primary site BD30) region.

Mussels from the backup sites are intended for analysis only if the primary sites are unable to fulfill laboratory requirements. Mussels collected from backup sites were disposed of in the case where mussels from the primary site supported target analyses.

Mussels deployed at primary deployment site for Lower South Bay (BA10) experienced high levels of mortality (>75%) due to sediment accumulating within the cages, which resulted in just over the target number of mussels required to support primary analyses with no archive. Should decrease of mussel mass during deployment time results in insufficient mass to support all target analyses, some prioritization of analyses may be required.

Unfortunately, due to shifting sediments at the backup station for LSB, Dumbarton Bridge (BA30), the entire mooring was buried resulting in zero survival. Therefore, there is no potential replacement of the backup site for the primary site in this case.

As is typical for river stations, abundances of live CFLU at target locations were insufficient (or potentially so) to support allocation of bivalves for all desired analyses. The BG30 site had approximately twice the volume of live CFLU collected at BG20, and may generate sufficient material for an archive.

All bivalves were allocated for analyses in the field immediately after sample retrieval / collection. Following allocation, all bivalves were immediately frozen on dry ice and returned to AMS for temporary storage in laboratory freezers. AMS then shipped all samples for chemical analysis frozen to AXYS for processing on October 31, 2016.

The number of bivalves allocated for each analysis by site are presented in Table 3. Sample handling protocols are presented in Table 4. Locations of bioaccumulation stations and clam harvesting areas are presented in Table 5 and Appendix A. Consistent with the SCP, all mussels collected as part of this project were either shipped for laboratory analysis or disposed of following the retrieval cruise.

In preparation for transition to deployments via acoustic release devices, AMS divers retrieved buoys and moorings from all deployment locations where possible. Divers were not able to retrieve the mooring at BA30 owing to the sedimentation burial issue.

Table 3. Number of Bivalves Allocated for Each Analysis by Site.

Site	Species	# Recovered	PBDEs	PAHs	Se	Algal Toxins	Archive	Growth	# Discarded	Survival (%)	Comments
T-0	MCAL	NA	10	20	10	5	105	30	NA	NA	
BA10	MCAL	300	10	20	10	5	19	0	0	21%	Burial – insufficient survival for growth or archive
BA30	MCAL	0	0	0	0	0	0	0	NA	NA	Full mortality – mooring completely buried
BA40	MCAL	196	10	20	10	5	105	30	15	99%	Only two cages recovered, the third fell from buoy upon retrieval
BB71	MCAL	294	0	0	0	0	0	0	291	99%	
BC10	MCAL	275	10	20	10	5	105	30	NR	NR	25 mussels compromised at deployment by failure of cage resulting in smaller recovery
BD20	MCAL	300	0	0	0	0	0	0	292	97%	
BD30	MCAL	307	10	20	10	5	105	30	121	98%	
BG20	CFLU	NA	X	NA	X	X	X	0	NA	NA	Residents only, possibly insufficient mass to support all analyses
BG30	CFLU	NA	X	NA	X	X	X	30	NA	NA	Residents only, possibly insufficient mass to support all analyses
T-1	MCAL	30	NA	NA	NA	NA	NA	30	NA	NA	For analysis of growth only (chemical analysis not required)

Notes:

- X – Indicates sample apportioned by volume.
- NA – Not applicable
- NC – Not calculable
- NR – Not reported

Table 4. Sample Handling for 2016 Bioaccumulation Program.

Sample	Container	Handling Requirements
Trace Elements	N/A	Not collected in 2016
AXYS Bulk Sample	1 gallon zip-top bag	Collect 150 organisms do not rinse, wrap in two layers of aluminum foil, place in zip-top bags, freeze or place on dry ice.
PAHs and PBDEs	N/A	Collected as split from bulk sample.
Algal Toxins	N/A	Collected as split from bulk sample. Sample material forwarded from AXYS to lab via AMS.
Selenium	N/A	Collected as split from bulk sample. Sample material forwarded from AXYS to lab via AMS.
Archive	N/A	Collected as split from bulk sample. Sample material forwarded from AXYS to lab via AMS.
Emerging Contaminants	N/A	Collected as split from bulk sample. Sample material forwarded from AXYS to lab via AMS.
Growth	1 gallon zip-top bag, double-bagged	Collect 30 organisms, rinse with site water, place in zip-top bags, freeze or place on dry ice.

Table 5. Coordinates for RMP Bivalve Stations for 2016.

Site	Lat	Long	Comments
BA10	37.46983	-122.06383	Channel marker "18"
BA30	37.51333	-122.13467	Channel marker "14"
BA40	37.54700	-122.19500	Channel marker "4"
BB71	37.69550	-122.33967	Channel marker "1" 1.65 nmi. SE of Hunters Point
BC10	37.81392	-122.35873	Piles 30m SW of Bay Bridge, center pile in only remaining set of dolphins
BD20	38.05900	-122.42367	Channel marker "4." Approx 1 nmi from channel marker "1" (replaced in 2006)
BD30	38.01667	-122.36750	Channel marker "P"; no ground line – mooring within body length of pile
BG20*	38.05570	-121.80593	Channel marker "8" N of Sherman Island
BG30*	38.02362	-121.80048	Channel marker "8" 0.75 nmi. E of Antioch Marina

Notes

* Approximate coordinates of dredging run starting point

3. Appendix A – Map of Deployment / Collection Locations for 2016 RMP Bioaccumulation Program

